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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : G01R 27/28, 27/06 — A1

(11) International Publication Number: WO 94/24576

(43) International Publication Date: 27 October 1994 (27.10.94)

(21) International Application Number: PCT/FI94/00138

(22) International Filing Date: 13 April 1994 (13.04.94)

(30) Priority Data:
921672 14 April 1993 (14.04.93) FI

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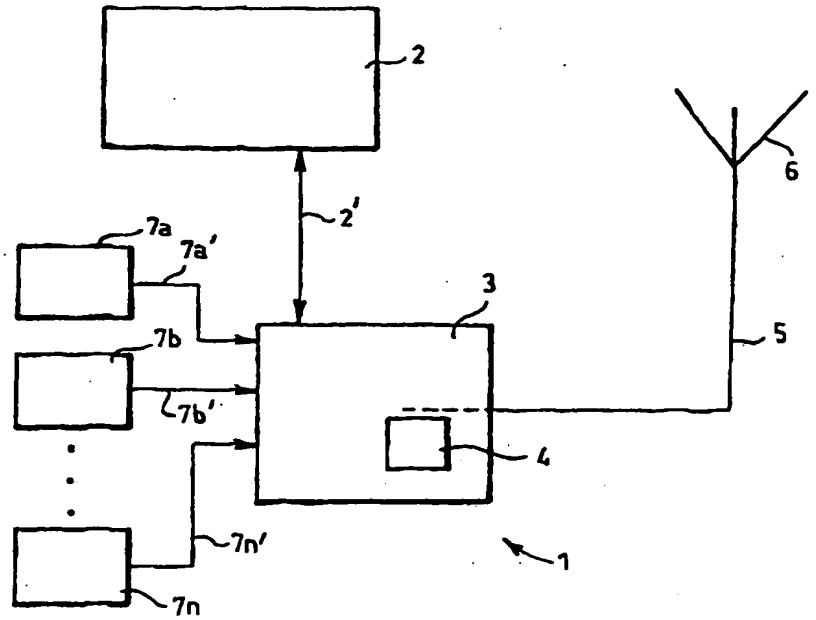
(81) Designated States: AU, CN, JP, NO, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: METHOD AND DEVICE FOR SUPERVISING THE CONDITION OF AN ANTENNA



(57) Abstract

The invention relates to a method and a device for supervising the condition of an antenna (6) by measuring the ratio of the magnitude (P_f) of a transmitted signal to the magnitude (P_r) of a signal reflected from the antenna (6) and by using, in addition to fixed alarm limits (TH_1), an adjustable alarm limit (TH_2), by means of which the condition of the transmitter device (1) can be found out.

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Method and device for supervising the condition of an antenna

The invention relates to a method for supervising the condition of a transmitter antenna by measuring the magnitude of a signal transmitted to an antenna line and correspondingly the magnitude of a signal reflected from the antenna through the antenna line by producing a measuring signal on the basis of the ratio of the magnitude of the reflected signal to that of the transmitted signal, said measuring signal switching off the transmitter device when it exceeds a first alarm limit of a fixed level.

The invention also relates to a device for supervising the condition of a transmitter antenna, said device comprising a measuring unit for measuring the magnitude of a signal transmitted to the antenna through an antenna line and correspondingly the magnitude of a signal reflected from the antenna through the antenna line, a circuit for producing a measuring signal on the basis of the ratio of the magnitude of the reflected signal to that of the transmitted signal, an alarm indicator, and a first alarm limit of a fixed level.

An essential part of radio systems, such as mobile phone systems and their base stations, is formed by receiver and transmitter antennas, the condition of which has a direct effect on the quality of transmissions in the radio systems. The condition of antennas can be supervised, for instance, by measuring their standing-wave ratio, i.e. the electric matching of the antennas to the rest of the receiving and transmitting system. Conventionally the measuring is carried out by measuring the power supplied to the antenna line and the power reflected from the antenna through the antenna line. The meter has to be a wideband

power meter, and thus the power supplied for the measurement has to be high in order for the signals received by the antenna not to interfere with the measurement. However, the use of high power usually causes distortion in electronic circuits, wherefore the measurement result is not reliable. Distortion can be reduced by various filters, but these reduce the accuracy of the measurement result. There are also solutions in which the problems described above have been solved by using as a measuring signal a measuring frequency outside the frequency band of the system and by using narrowband power measurement specifically matched to the measuring frequency.

European Patent Application No. 261 828 discloses an apparatus which measures a signal supplied from a measuring source directly to a network and a signal reflected from the network under analysis for determining the relative power. The way the apparatus analyzes the reflected and the transmitted signal is, however, a problem. For example, a sample signal extracted from the output power is applied to a measuring device over a path which is different from that of a sample signal extracted from the power reflected from the network under analysis. The fact that the signals propagate over different paths to the measuring device renders the relative value of the signals inaccurate. The inaccuracy of the relative value is caused by imperfections in the components on the signal path and inaccuracies formed during manufacture. For measurement, the measuring path must therefore always be calibrated separately by a standard signal. In practice this means that each combination of a measuring device and an antenna with its cables would have to be calibrated by a standard signal in connection with the manufacturing process.

The object of the present invention is to improve both the supervision of the condition of antennas and the accuracy and reliability of the measuring methods, and also to enable condition supervision during use.

The method according to the invention is characterized in that a second alarm limit of an adjustable level is used, that the level of the second alarm limit is adjusted within a predetermined range until it reaches the level of the measuring signal, that when the alarm limit reaches the level of the measuring signal, the state of the alarm indicator changes, whereby the change in the state of the alarm indicator indicates the level of the measuring signal, the condition of the transmitter device being determined on the basis of said level.

The device according to the invention is characterized in that the measuring unit is provided with a second alarm limit which can be set to change in a predetermined manner, that when the level of the second alarm limit reaches the level of the measuring signal, the state of the alarm indicator changes, whereby the change in the state of the alarm indicator indicates the level of the measuring signal, the condition of the transmitter device being determined on the basis of said level.

An essential feature of the invention is that the transmitter unit and the transmitter antenna connected to it are supervised continuously. The power of the signal which is transmitted is compared with the power which is reflected from the antenna. Another essential feature of the invention is that the measuring arrangement can be used for supervising the condition of the transmitter circuits and the transmitter antenna, whereby the need for adjustment and maintenance can be

appropriately determined on the basis of the result given by the measuring unit. Yet another essential feature is that a separate measuring signal, used only in connection with measurement, is not needed in the present arrangement but the measuring signal can be a normal signal passing through the transmitter circuits and antenna. A further feature is to use a single fixed alarm limit: when the level of the measuring signal exceeds the fixed alarm limit, an alarm is given and the transmitter circuits are switched off, wherefore the transmitter circuits are not overloaded. When a second adjustable alarm limit is used, it can be adjusted until it reaches the measuring signal formed on the basis of the ratio of the reflected power to the transmitted power. When the adjustable alarm limit reaches the level of the measuring signal, an alarm is given. However, the alarm does not cause the transmitter systems to be switched off, but from the level of the alarm limit it is possible to read a value describing the condition of the transmitter circuits and antenna.

An essential advantage of the invention is that the transmitter circuits and antenna are analyzed continuously in real time, and the operation of the apparatus is not interrupted during measurement. A further advantage is that the measuring signal is a signal that is normally transmitted in the system, wherefore a separate measuring signal is not needed, and the system does not have to be calibrated by means of a standard signal. The adjustable alarm limit renders it possible to obtain a value describing the condition of the transmitter device. Thereafter the value may be transmitted either via a radio path or through telephone lines to the maintenance point of a local maintenance company, whereafter it is decided whether the transmitter device requires local maintenance.

In the following, the invention will be described in greater detail with reference to the accompanying drawings, in which

Figure 1 is a block diagram of the device according to the invention, and

Figure 2 illustrates the changing of the adjustable alarm limit according to the invention in time domain.

Figure 1 shows a transmitter device 1 comprising a control unit 2, a combiner unit 3, a measuring unit 4 positioned within the combiner unit 3, a transmitter antenna 6 connected to the combiner 3 via an antenna line 5, and transmitter units 7a, 7b...7n. The control unit 2 controls the combiner 3 in order to make it combine signals supplied from the transmitter units 7a, 7b...7n in a suitable manner, thus preventing the amplifier units in the combiner 3 from being overloaded and ensuring that the channels remain at the disposal of predetermined transmitter units 7a, 7b...7n. Many other functions are also included in the control unit 2, but these functions are known per se and will not be dealt with more closely in this application. The control unit 2 is connected to the combiner 3 via a bus 2', in which bidirectional data can be transmitted both from the control unit 2 to the combiner 3 and vice versa. The transmitter units 7a, 7b...7n are connected to the combiner 3 via a unidirectional bus 7a', 7b'...7n'. When the combiner 3 has combined the signals supplied from the transmitter units 7a, 7b...7n, they are supplied after amplification to the antenna 6 through the antenna line 5. Simultaneously the measuring unit 4 measures the magnitude P_f of the signal transmitted to the transmitter antenna 6 and, correspondingly, the magnitude P_r of the signal reflected from the antenna. A measuring signal M_s, which

describes the quality of the transmitter system, is formed on the basis of the ratio P_r/P_f of the magnitudes of the reflected and transmitted signals. The signal magnitudes can be measured as an average of a certain span of time; the span of time used may be, for example, the duration of a transmission. The condition of the transmitter device 1 can be accurately deduced from the ratio of the magnitudes of the transmitted and reflected signals.

The use of alarm limits TH_1 and TH_2 is illustrated in Figure 2. When the value of the measuring signal M_s is one, the system is optimally tuned, and no power is reflected from the antenna 6 to the measuring unit 4 of the combiner 3. Correspondingly, when the value of the measuring signal M_s is three, i.e. when it exceeds the fixed alarm limit TH_1, the system is already in such a bad condition that the measuring unit gives an alarm to the control unit 2, which switches off the separate transmitter and amplifier units. The measuring unit 4 also comprises an adjustable alarm limit TH_2. Starting from the value describing the worst condition of the system, i.e. three, at a point of time t_0, the alarm limit TH_2 is adjusted step by step or continuously downwards until it gives an alarm after having reached the level of the measuring signal M_s at a point of time t_1. This value of the adjustable alarm limit TH_2 thus indicates the level of the measuring signal M_s and may vary between one and three, wherefore it gives a more accurate picture of the condition of the system. From the value of the adjustable alarm limit TH_2 it can be deduced when the transmitter station requires local maintenance and tuning.

The figures and the description pertaining to them are intended merely to illustrate the inventive

concept. In its details the invention may vary within the scope of the appended claims.

Claims

1. A method for supervising the condition of a transmitter antenna (6) by measuring the magnitude (P_f) of a signal transmitted to an antenna line (5) and correspondingly the magnitude (P_r) of a signal reflected from the antenna (6) through the antenna line (5) by producing a measuring signal (M_s) on the basis of the ratio of the magnitude of the reflected signal to that of the transmitted signal, said measuring signal switching off the transmitter device (1) when it exceeds a first alarm limit (TH_1) of a fixed level, c h a r a c t e r i z e d in that a second alarm limit (TH_2) of an adjustable level is used, that the level of the second alarm limit (TH_2) is adjusted within a predetermined range until it reaches the level of the measuring signal (M_s), that when the alarm limit (TH_2) reaches the level of the measuring signal, the state of the alarm indicator changes, whereby the change in the state of the alarm indicator indicates the level of the measuring signal (M_s), the condition of the transmitter device (1) being determined on the basis of said level.

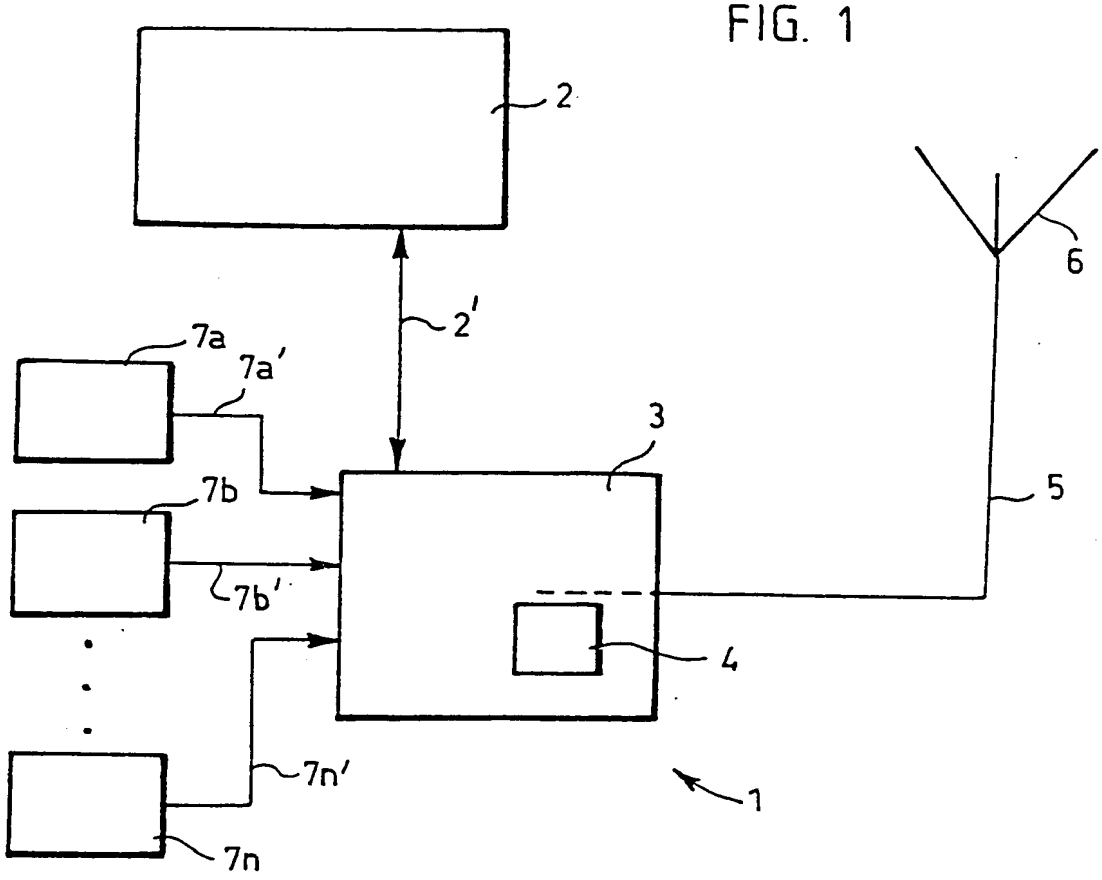
2. A method according to claim 1, c h a r a c t e r i z e d in that the level of the second alarm limit (TH_2) is adjusted by predetermined steps.

3. A device for supervising the condition of a transmitter antenna (6), said device comprising a measuring unit (4) for measuring the magnitude (P_f) of a signal transmitted to the antenna (6) through an antenna line (5) and correspondingly the magnitude (P_r) of a signal reflected from the antenna (6) through the antenna line (5), a circuit for producing a measuring signal (M_s) on the basis of the ratio of the magnitude of the reflected signal to that of the transmitted

signal, an alarm indicator, and a first alarm limit (TH_1) of a fixed level, characterized in that the measuring unit (4) is provided with a second alarm limit (TH_2) which can be set to change in a predetermined manner, that when the level of the second alarm limit (TH_2) reaches the level of the measuring signal (M_s), the state of the alarm indicator changes, whereby the change in the state of the alarm indicator indicates the level of the measuring signal (M_s), the condition of the transmitter device (1) being determined on the basis of said level.

4. A device according to claim 3, characterized in that the second alarm limit (TH_2) is adjustable by predetermined steps.

FIG. 1



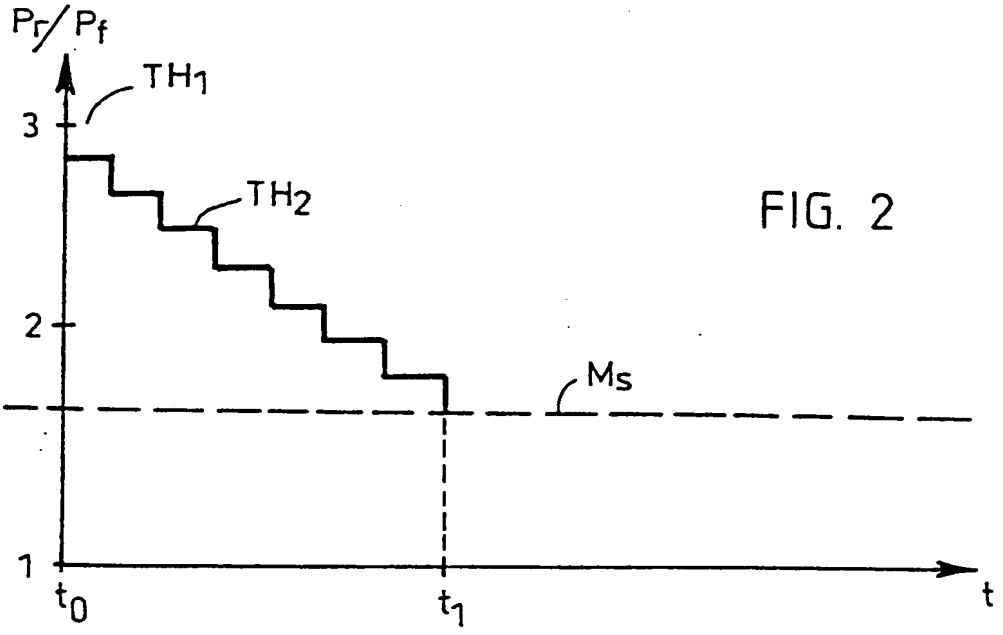


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 94/00138

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: G01R 27/28, G01R 27/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: G01R, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG: WPI, CLAIMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO, A1, 9203744 (TELENOKIA OY), 5 March 1992 (05.03.92), figure 1, abstract	1,3
A	EP, A1, 0261828 (FLANN MICROWAVE INSTRUMENTS LTD), 30 March 1988 (30.03.88), figures 1-2, abstract	1,3
A	WO, A1, 9301503 (TELENOKIA OY), 21 January 1993 (21.01.93), figure 1, abstract	1,3

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Information on patent family members

02/07/94

International application No.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A1- 9203744	05/03/92	AU-A- 8219791	17/03/92
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EP-A1- 0261828	30/03/88	GB-A- 2195454	07/04/88
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